# 3

# Naval Weapons Station Yorktown

## Yorktown, Virginia

CERCLIS #VA8170024170

## Site Exposure Potential

The 4,000-hectare Naval Weapons Stations (NWS) Yorktown facility on the York-James Peninsula in Virginia is bordered by the York River to the northeast and King Creek on the northwest (Figure 1). The York River is a tidal estuarine system that flows to Chesapeake Bay. Tributaries to the river include King, Felgates, Indian Field, and Ballard creeks. The Colonial National Historic Park is immediately southeast of the site; Highway 64 forms the southwestern site boundary.

Since 1918, the facility has been used for weapons maintenance, production, and storage. Asbestos, waste oils, paint, solvents, scrap metal, batteries, ordnance compounds, hydraulic and transmitting fluids, and pesticides have been disposed of or stored here. Twenty potential hazardous waste sites have been identified and grouped into six watersheds: Lee Pond, Roosevelt Pond, Felgates Creek, Indian Field Creek, Ballard Creek, and the York River (Figure 2; Table 1).

Surface water runoff and groundwater discharge to the creeks and rivers are potential sources of contaminant migration. Surface water runoff enters on-site storm water systems and open surface-water ditches and drains, and may discharge to on-site wetlands, creeks, and the York River.

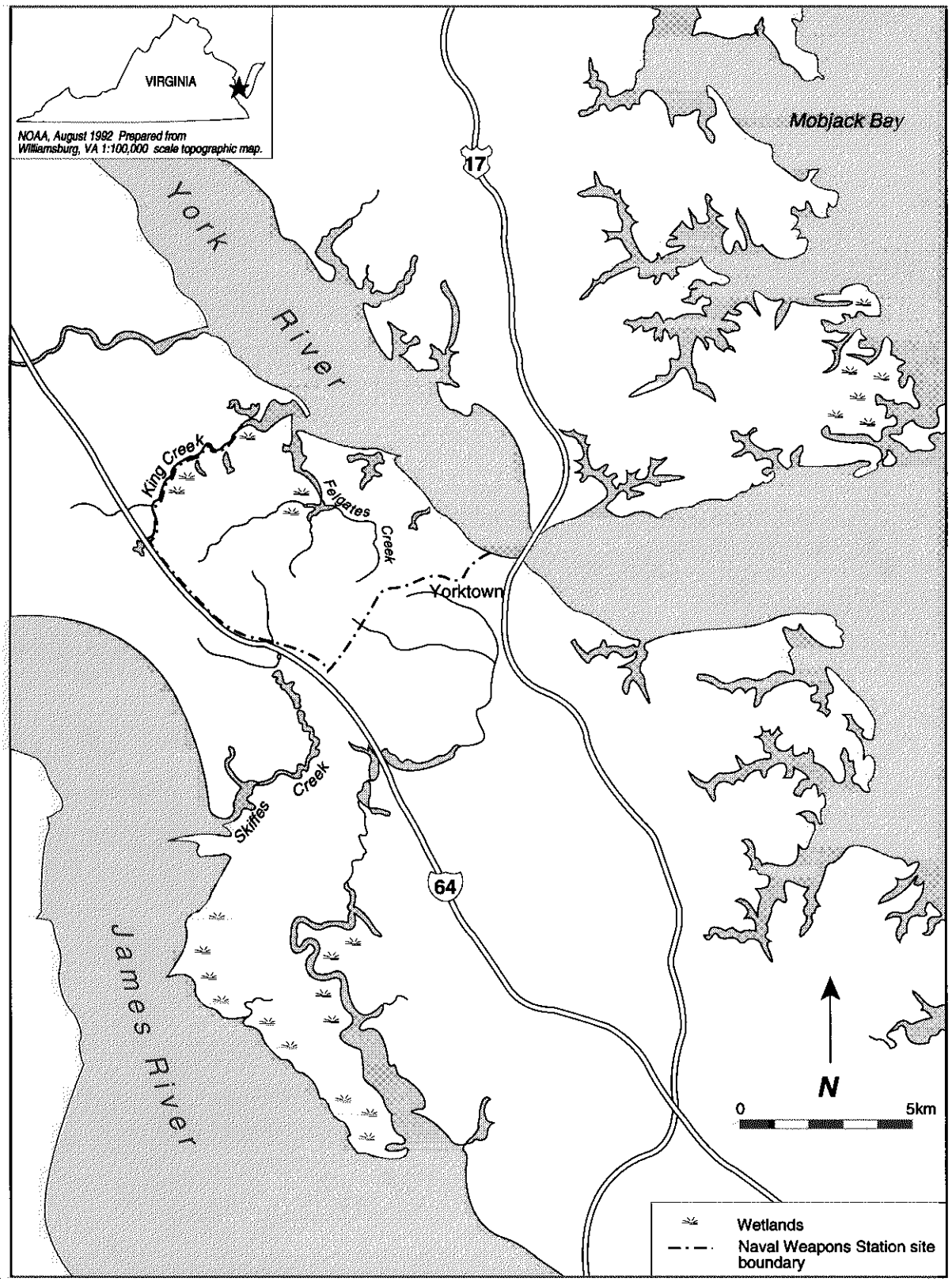


Figure 1. The Naval Weapons Station site, Yorktown, Virginia.

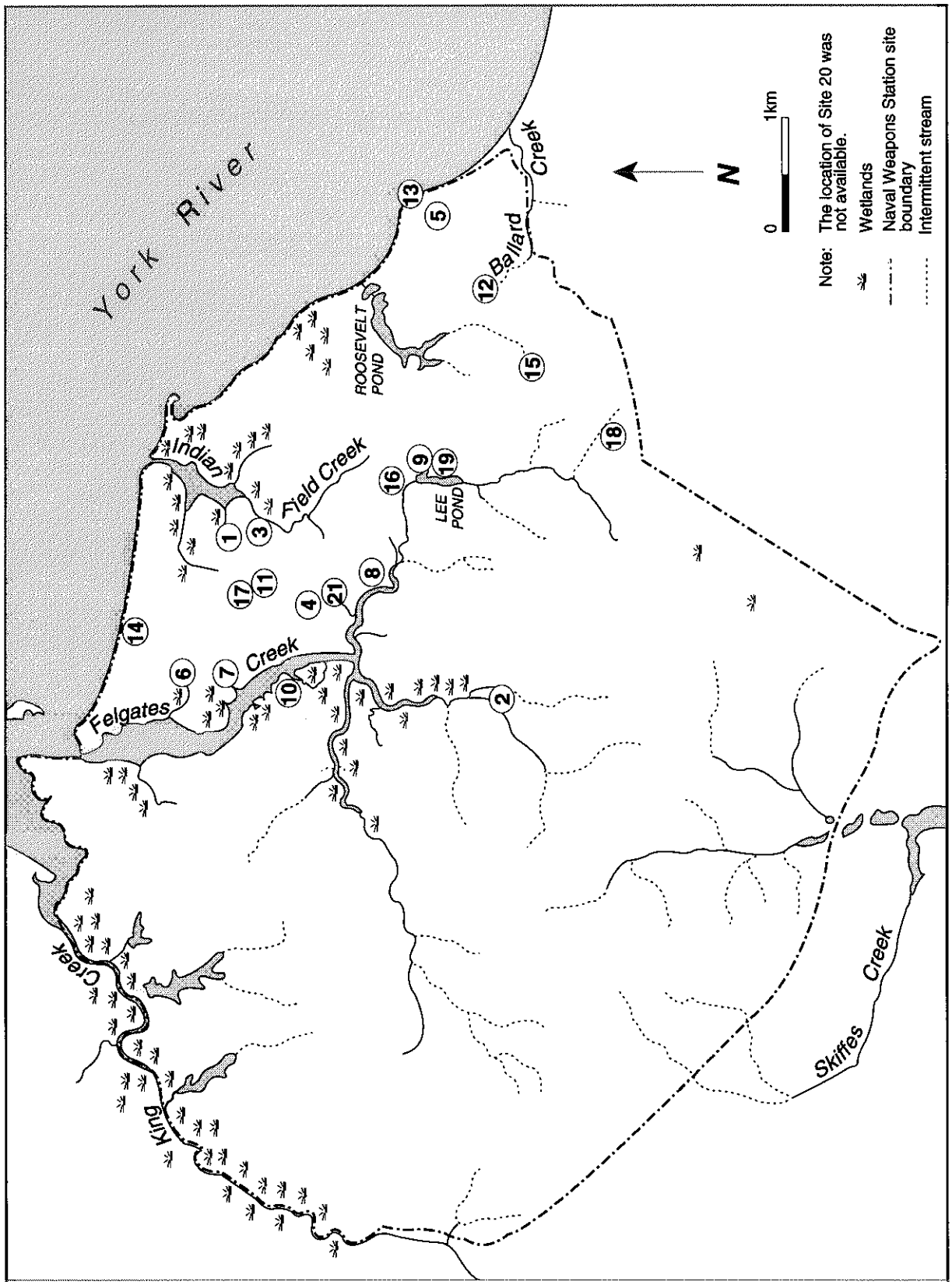


Figure 2. Detail of Naval Weapons Station Yorktown and station locations (Baker Environmental Inc. 1991; U.S.G.S. 1984a,b,c,e).

There are three major aquifers on the peninsula: the water-table, upper artesian, and principal artesian aquifers. Although there is no information on the depths, flow directions, and discharge points of the aquifers, well-drained soils increase the site's potential for contaminating the water

Table 1. Site names, periods of operation, and types of wastes disposed of at 20 hazardous waste sites identified at NWS Yorktown.

| Site of Concern | Period of Operation | Types of Wastes Disposed or Spilled |
|---|---|---|
| LEE POND WATERSHED | | |
| Site 9: Explosive Contaminated Wastewater Discharge Drainage Area | Late 1930s | trichloroethylene, TNT, RDX, HMX |
| Site 16: West Road Landfill | 1950s-1960s | batteries, banding material, PCB-contaminated pressure transmitting fluid, chemicals |
| Site 18: Building 476 Discharges | 1940s-1960s | mercury, nickel, cadmium, lead |
| Site 19: Conveyor Belt Soils at Building 10 | 1940-1970s | TNT, RDX |
| ROOSEVELT POND WATERSHED | | |
| Site 15: Electrical Shop Disposal Area | 1973 | copper and other wires, concrete, telephone poles, metals |
| FELGATES CREEK WATERSHED | | |
| Site 2: Turkey Road Landfill | 1940-1981 | mercury and zinc-carbon batteries, construction rubble, missile hardware, electrical devices, empty oil drums |
| Site 4: Burning Pad Residue Landfill | 1940-1975 | burning pad residues (e.g., TNT, RDX, 2,4-DNT), weapon batteries, fly ash, mine casings, electrical equipment, PCBs |
| Site 6: Explosive Contaminated Wastewater Impoundment | 1942-1975 | solvents (e.g., trichloroethylene, trichloroethane, cyclohexanone), explosive residues (e.g., TNT, RDX, 2,4-DNT) |
| Site 7: Plant 3 Explosive Contaminated Waste-water Discharge Area | 1945-1975 | explosive residues (e.g., TNT, RDX), trichloroethylene, cyclohexane |
| Site 8: NEDED Explosive Contaminated Waste-water Discharge Area | 1940-1975 | spent/neutralized acids, trichloroethylene, acetone, cyclohexane, explosive residues (e.g., TNT, RDX, 2,4-DNT, HMX) |
| Site 10: Felgate Crossing Fill Area | 1940s | plaster-filled mines, ordnance steel, inactive military hardware |
| Site 21: Battery and Drum Disposal Area | Unknown | VOCs, trace elements, pesticides, BNAs, PCBs |
| INDIAN FIELD CREEK WATERSHED | | |
| Site 1: Dudley Road Landfill | 1965-1981 | asbestos, oil, grease, paint, solvents, explosive contaminated carbon, appliances, scrap metal, plastics, lumber, packaging wastes, waste oil |
| Site 3: Group 16 Magazines Landfill | 1940-1970 | grease trap wastes, sludge from boiler cleaning operation, solvents (e.g., trichloroethylene, methylene chloride), Imhoff tank skimmings (oils) |
| Site 11: Aberdeen. Explosives Pits | 1930-1950 | TNT, RDX, HMX |
| Site 17: Holm Road Landfill | 1950s-1960s | PCB-contaminated hydraulic fluids, batteries from underwater weapons, scrap metals |
| BALLARD CREEK WATERSHED | | |
| Site 12: Barracks Road Landfill | 1925-mid-1960s | garbage, scrap wood, explosive contaminated packaging, solvents |
| YORK RIVER WATERSHED | | |
| Site 5: Surplus Transformer Storage Area | 1940-1981 | PCBs |
| Site 13: Building Rubble Disposal Site | Demolished in 1977 | asbestos |
| Site 14: Aviation Field | 1930s | munitions |

table aquifer. Shallow groundwater can potentially discharge to nearby surface water features or migrate downward toward the upper and principal artesian aquifers through leaks or cracks in the confining layers.

## NOAA Trust Habitats and Species

Habitats of concern to NOAA are the surface water, associated bottom substrates, and estuarine emergent wetlands associated with King, Felgates, Indian Field, and Ballard creeks, and the York River. Surface water and substrates of Roosevelt and Lee Ponds are potential secondary habitats of concern (Figure 2). Roosevelt Pond discharges directly to the York River, while Lee Pond flows into Felgates Creek.

Salinities in the York River near the site range from 15 to 20 ppt and fluctuate throughout the year depending on rainfall, saltwater intrusion, and urban runoff. The creeks entering the base from the York River are tidally influenced about 2 km inland from the river. The York River's substrate consists mainly of mud and sand; submerged aquatic vegetation in the river near the facility is primarily eel grass (*Zostera marina*; Olney personal communication 1992).

Wetlands and creeks within the base provide nursery and adult habitat for numerous trustee species (Table 2; Olney personal communication 1992; O'Reilly personal communication 1992). No one plant community dominates the brackish water marsh wetlands associated with King Creek, although large stands of saltmarsh cordgrass (*Spartina alterniflora*) predominate towards the more saline mouth of the creek. Felgates Creek branches into three prongs about 3 km from its narrow mouth, with saltmarsh cordgrass, cattail (*Typha spp.*), and saltmarsh bulrush (*Scirpus robustus*) dominating the marsh vegetation. Saltmarsh cordgrass also dominates the fringing marshes of Indian Field Creek (Silberhorn 1981).

Five species of anadromous fish use the York River for migratory and adult habitat: blueback herring, alewife, American shad, white perch, and striped bass (Olney personal communication 1992; O'Reilly personal communication 1992). Spot and Atlantic croaker commonly use this reach of the river during the spring and summer for adult forage and juvenile rearing. Resident species of the York River include large numbers of hogchoker, weakfish, and oyster toadfish. Historically there are an unknown amount of eastern oyster found in this reach of the river. There are catadromous American eel throughout the area.

Although limited data were available regarding the resource use of the creeks within the site, tidal exchange and proximity to the York River would suggest that trust species regularly use the creeks. Anadromous fish using the York River for migratory and adult habitat are considered likely to use the creeks throughout the base as nursery habitat.

Table 2. Major species that use theYork River near the Yorktown site.

| Species | | Habitat | | | Fisheries | |
|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Spawning Ground | Nursery Ground | Adult Forage | Comm. | Recr. |
| ANADROMOUS /CATADROMOUS SPECIES | | | | | | |
| Blueback herring | *Alosa aestivalis* | | ♦ | ♦ | ♦ | |
| American shad | *Alosa sapidissima* | | ♦ | ♦ | ♦ | |
| Alewife | *Alosa pseudoharengus* | | ♦ | ♦ | ♦ | |
| American eel | *Anguilla rostrata* | | ♦ | ♦ | ♦ | |
| White perch | *Morone americana* | | ♦ | ♦ | | |
| Striped bass | *Morone saxatilis* | | ♦ | ♦ | ♦ | ♦ |
| ESTUARINE /MARINE FISH | | | | | | |
| Bay anchovy | *Anchoa mitchilli* | ♦ | ♦ | ♦ | ♦ | |
| Atlantic manhaden | *Brevoortia tyrannus* | | ♦ | ♦ | ♦ | |
| Weakfish | *Cynoscion regalis* | ♦ | ♦ | ♦ | ♦ | ♦ |
| Gizard shad | *Dorosoma cepedianum* | ♦ | ♦ | ♦ | ♦ | |
| Banded killifish | *Fundulus diaphanus* | ♦ | ♦ | ♦ | | |
| Mummichog | *Fundulus heteroclitus* | ♦ | ♦ | ♦ | | |
| Spot | *Leiostomus xanthurus* | | ♦ | ♦ | ♦ | ♦ |
| Rough silverside | *Membras martinica* | | ♦ | ♦ | | |
| Atlantic silverside | *Menidia menidia* | | ♦ | ♦ | | |
| Inland silverside | *Menidia beryllina* | | ♦ | ♦ | | |
| Atlantic croaker | *Micropongonias undulatus* | | ♦ | ♦ | ♦ | ♦ |
| Oyster toadfish | *Opsanus tau* | ♦ | ♦ | ♦ | | |
| Summer flounder | *Paralichthys dentatus* | ♦ | ♦ | ♦ | ♦ | ♦ |
| Bluefish | *Pomatomus saltatrix* | | ♦ | ♦ | ♦ | ♦ |
| Winter flounder | *Pseudopleuronectes americanus* | ♦ | ♦ | ♦ | | ♦ |
| Northern puffer | *Sphoeroides maculatus* | | ♦ | ♦ | | ♦ |
| Hogchoker | *Trinectes maculatus* | ♦ | ♦ | ♦ | | |
| INVERTEBRATES | | | | | | |
| Blue crab | *Callinectus sapidus* | ♦ | ♦ | ♦ | ♦ | ♦ |
| Eastern oyster | *Crassostrea viginica* | | ♦ | ♦ | ♦ | ♦ |
| Hardshell clam | *Mercenaria mercenaria* | ♦ | ♦ | ♦ | ♦ | ♦ |
| Softshell clam | *Mya arenaria* | ♦ | ♦ | ♦ | ♦ | ♦ |

Juvenile (elvers) American eel periodically occur in high concentrations in the creeks. Numerous estuarine and marine species use the creeks within the site, including blue crab, eastern oyster, flounder, killifish, mummichog, silverside, soft shell clam, and weakfish (Loftin personal communication 1993). Roosevelt and Lee ponds provide habitat for numerous freshwater fishes. Although NOAA trust finfish and invertebrates are restricted from entering these ponds by several downstream barriers, American eel can breach the barriers and use both ponds (Loftin personal communication 1993; Wilson personal communication 1993).

The York River supports important recreational and commercial fisheries. Species commercially harvested in greatest numbers include American shad, Atlantic croaker, summer flounder, bay

anchovy, bluefish, weakfish, and blue crab (O'Reilly personal communication 1992). Popular sport fisheries include striped bass, weakfish, spot, Atlantic croaker, summer flounder, and northern puffer. Recreational and commercial crabbers harvest blue crab from March through November. There are no closures or health advisories for fish consumption reported for the area (Olney personal communication 1992).

There are no known endangered or threatened species near the site, although several species of endangered sea turtles (e.g., green, hawksbill, loggerhead, and Atlantic ridley turtles) feed in Chesapeake Bay. It is possible that any of these species may occasionally migrate up the York River near the site.

## Site-Related Contamination

Data collected during preliminary site investigations indicate that soil, groundwater, surface water, and sediment at the base are contaminated with trace elements, PAHs, pesticides, PCBs, and ordnance compounds (Baker Environmental, Inc. 1992). VOCs were also measured in on-site media, but at concentrations less than those known to threaten NOAA resources. The maximum concentrations of the trace elements detected at the site are summarized in Tables 3 and 4, along with applicable screening guidelines (Lindsay 1979; U.S. EPA 1986; Long and Morgan 1990). Contaminant data were available for sites in the Lee Pond, Felgates Creek, Indian Field Creek, Ballard Creek, and York River watersheds. Not all media were collected at all sites within these watersheds, and not all contaminants were analyzed in all media.

Lead and zinc were the only trace elements detected in soils collected from sites in the Lee Pond watershed at concentrations exceeding the average U.S. soil concentrations. Trace elements were not detected in groundwater, surface water, or sediment from the pond at concentrations exceeding screening guidelines. The total PAH concentration (150 mg/kg) in sediments collected from the pond exceeded the ER-L concentration (4 mg/kg); PAHs were not detected in any other media sampled within the watershed at high concentrations. The pesticide BHC was measured in groundwater (0.084 µg/l) from sites in the watershed and in surface water (0.057 µg/l) and sediment (16 mg/kg) from Lee Pond. There are no screening guidelines for BHC in any of these media. Concentrations of heptachlor detected in groundwater (0.024 µg/l) and of dieldrin detected in sediments (0.014 mg/kg) from Lee Pond were up to two orders of magnitude greater than their screening guidelines.

Concentrations of arsenic, cadmium, copper, lead, mercury, and zinc in soils from sites in the Felgates Creek watershed exceeded average U.S. soil concentrations. Except for arsenic and cadmium, these trace elements were also measured in groundwater from these sites at concentrations

Table 3. Maximum concentrations of trace elements in soils and sediments collected from four watersheds at the site.

| | Soil (mg/kg) | | | | | Sediment (mg/kg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lee Pond | Felgates Creek | Indian Field Creek | Ballard Creek | Average U.S.[1] | Lee Pond | Felgates Creek | Indian Field Creek | Ballard Creek | ER-L[2] |
| Trace Elements | | | | | | | | | | |
| Arsenic | NT | 11 | NT | NT | 5 | 7.5 | 13 | NT | 7.4 | 33 |
| Cadmium | ND | 2.6 | NT | NT | 0.06 | ND | 1.3 | NT | 7.2 | 5 |
| Chromium | 8 | 38 | NT | NT | 100 | 28 | 110 | NT | 63 | 80 |
| Copper | NT | 47 | NT | NT | 30 | 10 | 21 | NT | 570 | 70 |
| Lead | 14 | 92 | NT | NT | 10 | 32 | 170 | NT | 250 | 35 |
| Mercury | NT | 3.3 | NT | NT | 0.03 | NT | ND | NT | 0.68 | 0.15 |
| Nickel | 7.3 | 22 | NT | NT | 40 | ND | 14 | NT | 24 | 30 |
| Silver | NT | ND | NT | NT | 0.05 | 0.3 | 7.3 | NT | 2.4 | 1 |
| Zinc | 56 | 1,000 | NT | NT | 50 | 110 | 140 | NT | 730 | 120 |
| Ordnance Compounds | | | | | | | | | | |
| 2,4-DNT | 3.1 | ND | NT | NT | NA | ND | 17 | ND | ND | NA |
| HMX | ND | ND | NT | NT | NA | ND | 44 | ND | ND | NA |
| RDX | 2.7 | 850 | NT | NT | NA | ND | ND | 1.1 | ND | NA |
| TNT | 1430 | 3400 | NT | NT | NA | ND | 1240 | ND | 2.7 | NA |

1: Lindsay (1979).
2: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long and Morgan (1990).
NA: Screening level not available.
ND: Not detected at method detection limit.
NT: Not tested.

Table 4. Maximum concentrations of trace elements in groundwater and surface water collected from four watersheds at the site.

| | Groundwater (µg/l) | | | | Surface Water (µg/l) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lee Pond | Felgates Creek | Indian Field Creek | Ballard Creek | Lee Pond | Felgates Creek | Indian Field Creek | Ballard Creek | AWQC[1] |
| Trace Elements | | | | | | | | | |
| Arsenic | ND | 83 | 7.5 | ND | ND | 9.4 | 3.7 | ND | 36 |
| Cadmium | NT | 85 | 1.0 | ND | 9 | ND | NT | 4 | 9.3 |
| Chromium | ND | 260 | ND | ND | 6 | 8 | 14 | 6 | 50 |
| Copper | 5.1 | 82 | ND | ND | 4 | 13 | ND | 6 | 2.9* |
| Lead | 1.8 | 110 | 1.1 | ND | ND | 85 | 82 | ND | 8.5 |
| Mercury | NT | 0.33 | ND | ND | NT | ND | 0.26 | 0.2 | 0.025 |
| Nickel | NT | 75 | 13 | 11 | 6 | ND | ND | 15 | 8.3 |
| Silver | ND | 15 | ND | ND | ND | 9.4 | 18 | ND | 0.92 |
| Zinc | 72 | 19,000 | 140 | 16 | 44 | 73 | 31 | 110 | 86 |
| Ordnance Compounds | | | | | | | | | |
| 2,4-DNT | NT | ND | ND | ND | ND | ND | ND | ND | NA |
| HMX | NT | ND | 0.72 | ND | 0.17 | 1.7 | ND | ND | NA |
| RDX | NT | ND | 9.0 | 0.011 | 23 | 2.0 | ND | ND | NA |
| TNT | NT | ND | 0.13 | 0.05 | 19 | 0.55 | ND | 9.0 | NA |

1: Ambient water quality criteria for the protection of aquatic organisms. Marine chronic criteria presented (U.S. EPA 1986).
*: Acute criteria presented; chronic criteria not available.
ND: Not detected at method detection limit.
NT: Not tested.

exceeding marine AWQC by an order of magnitude. Total PAHs (17 mg/kg) and PCBs (0.94 mg/kg) were detected in soils collected from sites in the Felgates Creek watershed. There are no screening guidelines for PAHs or PCBs in soils. Two pesticides were measured in media from sites in the watershed at high concentrations: BHC in groundwater (0.006 µg/l), surface water (190 µg/l), and sediment (6.5 mg/kg) from Felgates Creek; and endosulfan sulfate in soils (0.61 mg/kg).

Trace elements were not tested in soils from the sites or in sediments from the creek and were not detected at elevated concentrations in groundwater from sites in the Indian Field Creek watershed. However, lead, mercury, and silver were measured in surface water from Indian Field Creek at concentrations exceeding marine chronic AWQC. BHC (2.3 mg/kg) was detected in sediment from Indian Field Creek, but was either not detected or not tested for in other media from the watershed.

Soils collected from the one site identified in the Ballard Creek watershed were not analyzed for trace elements. Concentrations of trace elements in groundwater did not exceed ten-times marine chronic AWQC, although they were measured in surface water and sediments from the creek at concentrations exceeding applicable screening guidelines. Sediments from Ballard Creek also contained elevated concentrations of total PAHs (23 mg/kg), BHC (0.084 mg/kg), DDT (0.062 mg/kg), and chlordane (2.8 mg/kg). These organic compounds exceeded available screening guidelines by one to three orders of magnitude.

Soil was the only medium collected from the York River shoreline. PCBs were measured at a maximum concentration of 1.9 mg/kg at Site 5.

Ordnance compounds, including TNT, RDX, HMX, and 2,4 -DNT were detected in samples of different media types collected throughout the Yorktown site (Tables 3 and 4). The highest concentrations of ordnance compounds in soil were detected in samples collected from Sites 6, 7, and 19. Screening guidelines for ordnance compounds in soils and sediments were not available. RDX was detected at the highest concentrations in groundwater and surface water. In general, the maximum concentrations of ordnance compounds in groundwater and surface water were found in samples collected from Sites 4 and 9, respectively. Screening guidelines have not been developed for ordnance compounds in surface water.

## Summary

The creeks and wetlands around the base are vital nursery grounds and adult foraging habitat: 60 percent of commercial and recreational fish and shellfish depend on these types of habitats during at lease one stage of their life cycles. Soils and groundwater are contaminated by trace metals,

PAHs, PCBs, and pesticides. Except for PCBs, all of these contaminants have been detected in either surface water or sediments in these habitats. These contaminants are extremely persistent in aquatic systems and may threaten sensitive life stages of NOAA trust species or their supporting habitat.

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